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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> :  F16K 15/14		A1	(11) International Publication Number: <b>WO 98/01690</b>  (43) International Publication Date: 15 January 1998 (15.01.98)		
(21) International Application Number: PCT/GB97/01777  (22) International Filing Date: 2 July 1997 (02.07.97)		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).			
(30) Priority Data: 9613955.5 3 July 1996 (03.07.96) GB		Published With international search report.			
(71) Applicant (for all designated States except US): CONVAC LIMITED [GB/GB]; Unit 3, Enterprise Works, Lockfield Avenue, Brimsdown, Enfield, Hertfordshire EN3 7RE (GB).  (72) Inventor; and  (75) Inventor/Applicant (for US only): LASKOWSKI, Henry [GB/GB]; 56 Buckland Court, Mintem Street, London N1 5EP (GB).  (74) Agents: POWELL, Stephen, David et al.; Williams, Powell & Associates, 34 Tavistock Street, London WC2E 7PB (GB).					
(54) Title: <b>SEALING DEVICES</b>					
(57) Abstract					
<p>A sealing device for a vacuum air opening (10) of a dust bag or other dust collecting container (5) for a vacuum cleaner, has an elastic membrane (1) deflected and centrally fixed in a vacuum air opening tube (4) by means of a fixing element (2). Deflection of the flexible membrane (1) produces forces acting upon a part-spherical surface (7) of the vacuum air opening tube (4), sufficient enough to ensure tight sealing of the vacuum air opening (10) and preventing any spillage of dust through the opening (10). The elastic membrane (1) is protected by a dome (3) with an opening (6) for vacuum air flow. Alternatively the membrane (1) may be mounted on a stem element (9) extending from the dome (3).</p>					

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## SEALING DEVICES

The present invention relates to sealing devices, and more particularly to a device for sealing an opening in a container of a vacuum cleaner or other suction device for collecting dust or other fine material. A preferred embodiment is suitable for picking up and collecting fine toner particles from a photocopying machine.

A problem with suction devices for collecting toner particles is leakage of the toner from the collecting bag or other container. Because the particles are so fine, even the slightest imperfection in a seal leads to escape of the toner and a consequent mess. Existing containers are provided either without any closure member or with a closure member which has one or more disadvantages.

G.B. Patent Application 2109092 discloses a dust filter bag with a check valve flap of resilient material which is hinged at one side and is biased to close an opening. However, such an arrangement can have uneven sealing pressure around the edges of the flap and dust particles, or other contaminants, could accumulate around the hinge leading to possible incomplete closure of the flap.

The disclosure of GB 1043327 is also relevant, but this relates to a different technical field from the present invention. Here, the sealing device is associated with an inlet for air or other gas which diffuses into a liquid. To assist satisfactory aeration, part of the inlet has a hyperboloid shape. A sealing cover for the inlet is mounted on a central bolt (Fig. 3) or on radially extending ribs (Figs. 4 and 5).

The present invention seeks to provide an improved sealing arrangement.

According to a first aspect of the present invention, there is provided a sealing device for suction cleaning apparatus comprising a resilient closure member arranged in a passage for dust-carrying air, wherein the closure member can be selectively opened, to allow the passage of air, or closed by seating against a

peripheral surface of the passage, characterised in that the closure member is generally circular and that the peripheral surface constitutes part of a sphere.

The part-spherical nature of the peripheral valve-sealing surface ensures that an optimal seal is provided over the entire surface. There is no tendency for an increase in pressure to cause the edges of the closure member to curl or bend away from the peripheral surface as in the case of planar or other non-spherical shapes.

In a preferred arrangement, the peripheral surface is in the form of a relatively narrow ring adjacent to the passage wall. This leaves a large central orifice to permit a high flow of air, while achieving a high-quality seal.

Preferably, the arc subtended by the part-spherical surface at the centre of the notional sphere amounts to  $2^\circ$  to  $20^\circ$ , preferably  $5^\circ$  to  $10^\circ$ .

In a first preferred arrangement, the closure member is supported at a central region thereof by one or more spokes extending from the wall of the passage in a spider-type arrangement. This arrangement provides a uniform sealing effect around the entire circumference of the closure member.

In a second preferred arrangement, the closure member is supported at a central region thereof on a stem element fixed to the passage and located downstream of the closure member in the direction of air flow. A particular advantage of this arrangement is that there is no obstacle upstream of the closure member which could cause clogging or build-up of dust etc which might interfere with the sealing action. For example if a piece of string or other material snags at a location upstream of the closure member it could permanently extend through the closure orifice and prevent correct seating of the closure member, leading to leakage of dust. By locating the stem element downstream of the closure member, any snagged items or clogged materials are clear thereof. Thus they do not interfere

with closure of the member and there is a good chance that, when the member is opened again, any blockage or snagging is cleared by the next flow of air. This support arrangement for the closure member constitutes a separate aspect of the present invention.

Accordingly, a second aspect of the present invention provides a sealing device comprising a resilient closure member arranged in a fluid flow passage, wherein the closure member can be selectively opened, to allow the passage of air, or closed by seating against a peripheral surface of a wall of the passage characterised in that the closure member is supported at a central region thereof by a stem element fixed to the passage wall at a location downstream of the closure member in the direction of fluid flow.

The sealing device may incorporate a protective dome integral with the passage and located downstream of the closure member. The dome protects the closure member from accumulations of dust and also creates an air flow downstream of the closure member to carry dust well away therefrom.

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, of which:

Figure 1 shows a cross-section of a sealing device in accordance with a first embodiment;

Figure 2 shows a view A of the sealing device of Figure 1; and

Figure 3 shows a cross-section of a sealing device in accordance with a second embodiment.

As shown in Figure 1, the sealing device of a vacuum air opening for a dust bag

or other dust collecting container comprises a closure member in the form of an elastic membrane 1 held in position by a fixing element 2, a protective dome 3 with one or more openings 6 for a vacuum air flow, a vacuum air flow tube 4 with a part-spherical surface 7, and a dust bag or other dust collecting container wall 5.

Figure 2 shows the fixing of the elastic membrane 1 into the vacuum air opening tube 4, by means of one or more spokes 8, directed to the centre of the tube 4, where the fixing element 2 of the elastic membrane 1 is located. As shown in Figure 1, element 2 holds the centre of the membrane 1 slightly to the right of a straight line joining the top and bottom of surface 7. This means that the membrane 1 is slightly depressed and its edges engage the surface 7 with a suitable contact pressure.

The dome 3 directs dust-laden air in a turbulent flow away from the closure orifice. It also protects the orifice from circulating dust returning to the orifice and clogging it.

Deflection in the centre of the elastic membrane 1 increases the rigidity of the membrane and provides sufficient contact force acting on the spherical surface 7 to obtain a tight sealing of the vacuum air opening tube 4 and to prevent any spillage of dangerous dust through a vacuum air opening 10 of a dust bag or other dust collecting container 5.

Under normal working conditions of a vacuum cleaner, the elastic membrane 1, due to its elasticity, deflects (to the left in Fig. 1) even further allowing mixture of air and dust to flow from right to left freely between the spherical surface 7 of the vacuum air opening tube 4 and the elastic membrane 1. Even the smallest reversed pressure of air or dust particles on the concave surface of the elastic membrane 1, increases forces acting upon the spherical surface 7. This even more increases the sealing action of the mechanism which effectively stops dust escaping from the dust

bag or other dust collecting container 5.

In Figure 3 is shown another embodiment in which the elastic membrane 1 is fixed to the vacuum air opening tube 4 by means of a single supporting stem or pole element 9, fixed to the protective dome 3. Again the centre of the membrane 1 is held in a position to exert suitable contact pressure on surface 7.

The sealing devices as shown in Figure 1 or 3, and described above, can each be constructed as a permanent or fully removable part of a dust bag or other dust collecting container 5. Conventionally, such containers have a removable cap to prevent dust entering the container during storage before use. The incorporation of a sealing device in accordance with the invention avoids the need for this extra cap, since it already provides an effective and long-acting seal. It can also form a part of a vacuum cleaner itself onto which a dust bag or other dust collecting container is fixed.

The above-described sealing devices are especially suitable for use in apparatus for cleaning up and collecting toner particles from photocopying machines. Container 5 may be a replaceable cartridge for insertion in a corresponding vacuum-cleaning device. By preventing any toner leakage, they contribute to a clean and healthy environment. It can also be used to collect asbestos material or any particulate matter.

In modifications the surface 7 may have a planar, conical or other curved configuration; however the sealing effect is not as effective as with a surface forming a section of a sphere. Dome 3 may be omitted; if desired stem element 9 may be angled and extend directly from the wall of passage 4.

## CLAIMS

1. A sealing device for suction cleaning apparatus comprising a resilient closure member (1) arranged in a passage (4) for dust-carrying air, wherein the closure member can be selectively opened, to allow the passage of air, or closed by seating against a peripheral surface (7) of the passage, characterised in that the closure member (1) is generally circular and that the peripheral surface (7) constitutes part of a sphere.
2. A sealing device according to claim 1, wherein the part-spherical surface (7) forms a complete ring around the internal wall of the passage (4).
3. A sealing device according to claim 2, wherein the arc subtended by the part-spherical surface at the centre of the notional sphere amounts to 2° to 20°.
4. A sealing device according to any preceding claim, wherein a protective dome (3) is provided integral with the passage (4) and located downstream of the closure member (1).
5. A sealing device according to any preceding claim, wherein the closure member is supported at a central region thereof by one or more spokes (8) radially extending from the internal wall of the passage (4).
6. A sealing device according to claim 4, wherein the closure member is supported at a central region thereof by a stem element (9) extending from the dome (3).
7. A sealing device comprising a resilient closure member (1) arranged in a fluid flow passage (4), wherein the closure member can be selectively opened, to allow the passage of air, or closed by seating against a peripheral surface (7) of a

wall of the passage, characterised in that the closure member is supported at a central region thereof by a stem element (9) fixed to the passage wall at a location downstream of the closure member in the direction of fluid flow.

8. A sealing device according to claim 7, wherein the stem element (9) is mounted on a protective dome (3) integral with the passage (4).

9. A dust collecting container having an inlet aperture sealed by a sealing device in accordance with any preceding claim.

10. A suction cleaner having an outlet aperture sealed by a sealing device in accordance with any of claims 1 to 8.

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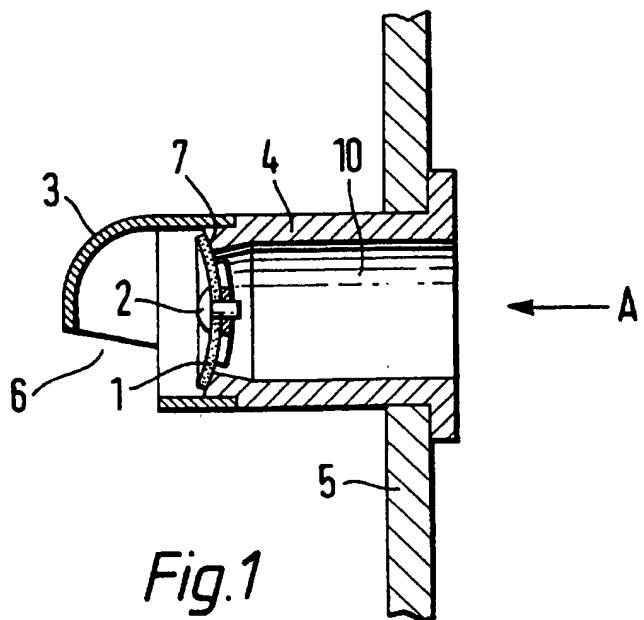


Fig. 1

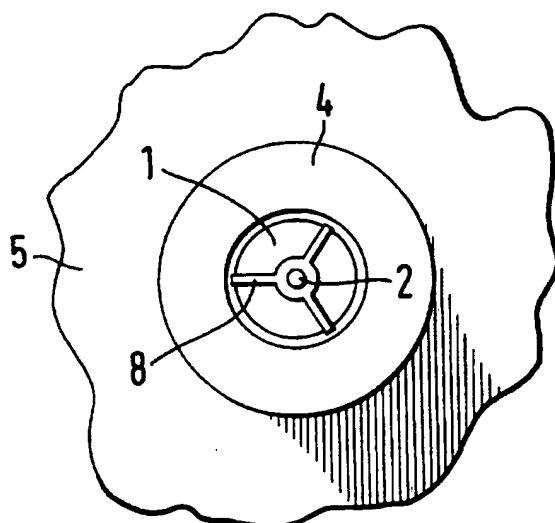


Fig. 2

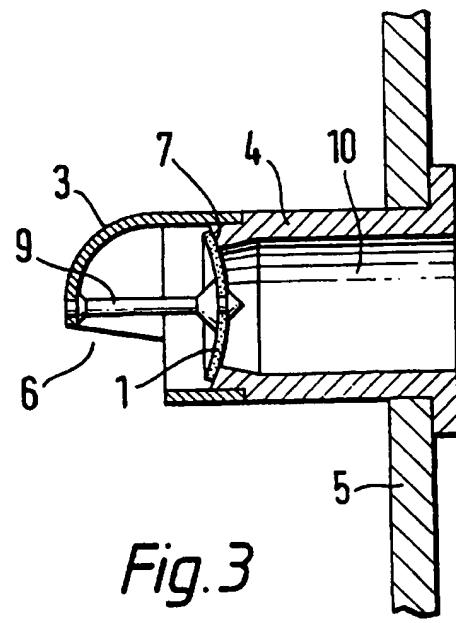


Fig. 3

## INTERNATIONAL SEARCH REPORT

International Application No

PC GB 97/01777

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 F16K15/14

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 4 749 003 A (LEASON) 7 June 1988 see figures 4,5	5
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Date of the actual completion of the international search

15 October 1997

Date of mailing of the international search report

27.10.97

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